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**Title:** He-3 Based Neutron Detector, Basic Troubleshooting

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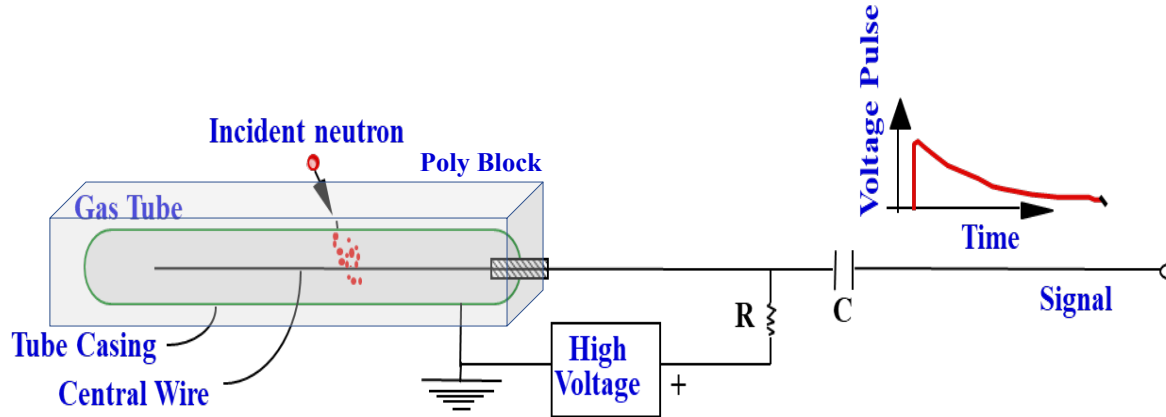
# He-3 Based Neutron Detector, Basic Troubleshooting

Carlos Rael, NEN-1

January 18, 2022

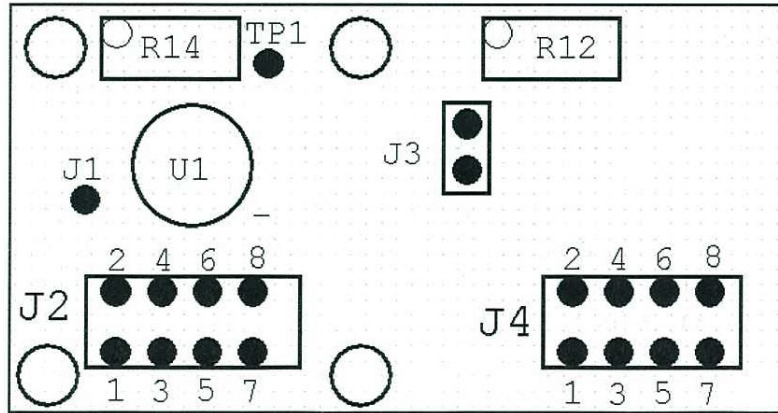
# Neutron Detection

- Uses polyethylene moderated  $^3\text{He}$  proportional counters.
- For thermal neutrons, the reaction is:  $n + ^3\text{He} \rightarrow p + ^3\text{H} + 765 \text{ keV}$
- Resulting charged particles highly ionize gas.
- Collection of charge becomes electrical pulse

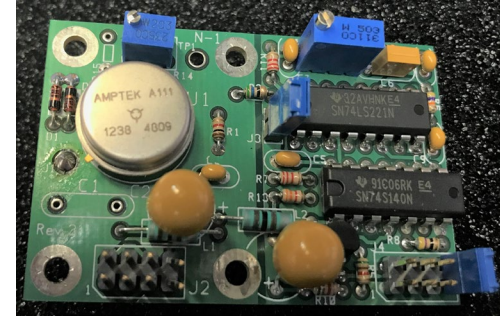


# Amplifiers

- Amptek Amplifier
- PDT10A-HN



Commonly used amplifiers in  
He-3 Based detectors



J2	J4
Pins 1,2,5,6 (NC)	Pin 2 jumper to pin 1
Pins 4,8 (+5V)	Pin 4 Ext. PCB Inhibit
Pins 3,7 (GND)	Pin 6 LED Driver out
J3	Pin 8 Digital signal out
Enable Jumper In/Disable Jumper out	Pins 1,3,5,7 Digital GND

# Troubleshooting Logic

## How to approach the problem

- Are my cables plugged in correctly?
  - Both at the detector side and the shift register side
    - This is especially important in a complex installation
- Do I have low voltage power and high voltage?
  - Is low voltage supposed to be +5 V or +12 V?
- Is the shift register plugged into AC power and turned on?

**If the answers are yes to these questions, time to Troubleshoot**

# Electronic Troubleshooting tools

- Multimeter
  - Measures both AC and DC voltages up to ~600 Vdc
  - Measures Resistance or Ohms (continuity)
  - Less Common Uses
    - Current (circuit needs to be broken)
    - Capacitance (I have never used it before)
    - Frequency and Temperature (need special probes)



# Components Most Likely to Cause Detector Problems

- Power Supplies
  - Must be capable of accepting Host Country Power---Voltage and Frequency
- Cables
  - Connectors are fragile and easily broken
- Amplifiers
  - Can be broken easily by connecting the wrong voltage
  - Can be wired incorrectly
  - Can be tampered with by the Host Country
- OR Box
  - Must be powered (+5V)
  - Dip switches need to be set correctly



# NDA Instruments for Safeguards In Japan (Rokkasho)

- TCVS– Uses PDT10A-HN Amplifiers
- VCAS– Uses PDT10A-HN Amplifiers and Fission Chambers
- WCAS– Uses Amptek A111 Amplifiers
- WCAS-B– Uses Amptek A111 Amplifiers
- iPCAS– Uses Amptek A111 Amplifiers
- UCAS– Uses PDT10A-HN Amplifiers
- AVIS– Uses Amptek A111 Amplifiers
- AFAS– Uses Amptek A111 Amplifiers
- iPCAS2—Uses Amptek A111 Amplifiers

# Troubleshooting

- Amplifier
  - Check for +5V or + 12 V depending on the Amplifier
  - Check Continuity using the Voltmeter
  - Check that it is wired correctly using the System drawings
- OR Box
  - Is it powered (+5V)
  - Are the dip switches set correctly
- Cables
  - Are all the connectors in good shape?

# Troubleshooting continued

If all these things are correct and there is still an issue

- It is time to contact LANL for further assistance in correcting the issue